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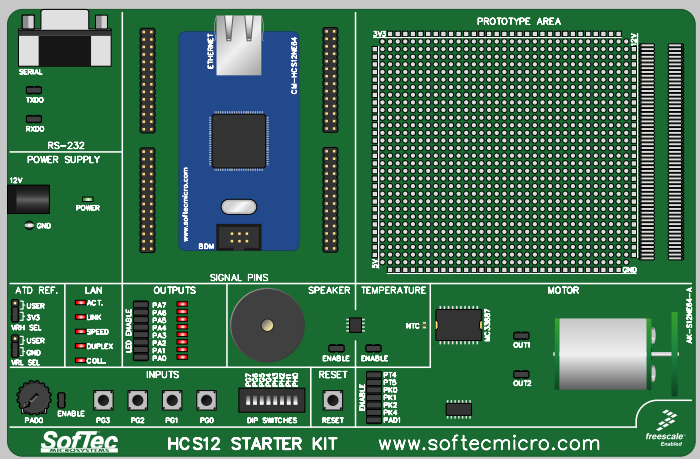
STARTERKIT

AK-S12NE64-A

User's Manual



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MICROSYSTEMS

Development Tools for the Embedded World

AK-S12NE64-A

Starter Kit for Freescale MC9S12NE64

User's Manual

Revision 1.0

SofTec MICROSYSTEMS

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0 Before Starting

0.1 Important Notice to Users

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0.2 Required Skills

In order to beneficially use the AK-S12NE64-A Starter Kit, you should be acquainted with certain skills, ranging from hardware design to software design. In particular, you should possess knowledge of the following:

- TCP/IP knowledge;
- Programming knowledge (Assembly and C);
- Microcontroller systems;
- HCS12 architecture knowledge.

1 Overview

1.1 What is the AK-S12NE64-A Starter Kit?

The AK-S12NE64-A Starter Kit is an integrated system designed to provide the user with a complete, ready-to-use embedded Ethernet application. The Starter Kit is built around the Freescale MC9S12NE64 microcontroller, which has a built-in, dedicated Ethernet peripheral. The Starter Kit demonstrates how effectively the MC9S12NE family of microcontrollers can be used in real-world embedded Ethernet applications.

The Starter Kit is composed of:

- A general purpose evaluation board (including LEDs, a DC motor, a temperature sensor, a buzzer, a serial connector, a potentiometer, DIP-switches and push-buttons);
- A “Core Module” board (including the MC9S12NE64 microcontroller, external FLASH and EEPROM memory, an Ethernet connector and a BDM connector);
- An AC power adapter;
- Ethernet and serial cables;
- Software (including free source code of the TCP/IP stack).

The Starter Kit can be used in two ways:

1. **For demonstration purposes.** The Starter Kit works as a web server. Connect the board to your local network and use a standard browser to access HTML pages. A JAVA applet is provided which allows the board to be viewed/controlled through a browser. With the provided software utilities you can upload your own HTML pages, images, etc. and access them through any PC in your LAN.
2. **For user application development.** A complete, integrated development environment is provided, which allows you to write your own software, download it to the MC9S12NE64 microcontroller and debug it. Downloading and debugging your application is possible

through a serial monitor pre-programmed into the microcontroller. The Starter Kit includes full source codes of the TCP/IP protocol together with full documentation for an easy porting to your custom application.

1.2 MC9S12NE64 Overview

The MC9S12NE64 is a 112-/80-pin low-cost, low-end connectivity applications MCU. The MC9S12NE64 features standard on-chip peripherals, including a 16-bit central processing unit (CPU12), 64 Kbytes of FLASH EEPROM, 8 KB of RAM, Ethernet Media Access Controller (EMAC) with integrated 10/100 Mbit/s Physical transceiver (EPHY), two asynchronous serial communications interface modules (SCI), a serial peripheral interface (SPI), one Inter IC Bus (IIC), a 4-channel 16-bit timer module (TIM), a 8-channel 10-bit analog-to-digital converter (ADC), up to 21 pins available as Keypad Wake-Up inputs (KWU) and 2 additional external asynchronous interrupts.

The inclusion of a PLL circuit allows power consumption and performance to be adjusted to suit operational requirements. Furthermore, an on-chip bandgap based voltage regulator (VREG) generates the internal digital supply voltage of 2.5 V (VDD) from a 3.15 V to 3.45 V external supply range.

The MC9S12NE64 microcontroller has full 16-bit data paths throughout. The 112 pin package version has a total of 70 I/O port pins and 10 input only pins available. The 80 pin package version has a total of 38 I/O port pins and 10 input only pins available.

1.3 OpenTCP Software

The AK-S12NE64-A Starter Kit includes full source codes of the OpenTCP Open Source project (developed by Viola Systems) together with full documentation for an easy porting to your custom application.

The OpenTCP Open Source project brings a high-quality TCP/IP stack to embedded systems. Entirely written in C, it allows easy porting to any existing microcontroller platform for which a C compiler is available.

The OpenTCP Open Source supports the following protocols and services:

- ARP
- BOOTP
- DHCP Client
- DNS Client
- HTTP Web Server
- POP3 Client
- SMTP Client
- TCP
- IP
- TFTP Client
- UDP
- ICMP

1.4 TCP/IP Protocol Documentation

Detailed information about the TCP/IP protocol and related protocols (HTTP, UDP, SMTP, POP3, etc.) is beyond the scope of this user manual. Full information is easily available from other sources.

All of the protocols in the TCP/IP suite are defined by documents called Requests For Comments (RFC). We suggest to visit the site *http://www.ietf.org*, where all of the TCP/IP RFCs are available.

For example, a good starting point is the *"RFC 1180: Tutorial on TCP/IP"* document.

1.5 CodeWarrior Integrated Development Environment

The AK-S12NE64-A Starter Kit comes with a free version of CodeWarrior Development Studio for HC(S)12 Microcontrollers, Special Edition.

CodeWarrior Development Studio for HC(S)12 is a powerful and easy-to-use tool suite designed to increase your software development productivity. Its Integrated Development Environment (IDE) provides unrivaled features such as Processor Expert application design tool, full chip simulation, Data

Visualization and project manager with templates to help you concentrate on the added value of your application.

The comprehensive, highly visual CodeWarrior Development Studio for Freescale HC(S)12 Microcontrollers enables you to build and deploy HC(S)12 systems quickly and easily. This tool suite provides the capabilities required by every engineer in the development cycle, from board bring-up to firmware development to final application development.

Without a license key, the product will run in a 1 KB code-size limited demonstration mode.

To break the 1 KB limit, you have two options:

1. Contact Metrowerks to request an unlimited period, free license key to increase the code size limit to 12 KB;
2. Contact Metrowerks to request a 30-day limited, free license key to run the compiler without limitations.

Please note, however, that the OpenTCP source code is larger than 12 KB, and therefore the first option will not allow you to compile the OpenTCP project.

This documentation covers the basic setup and operation of the CodeWarrior IDE, but does not cover all of its functions. For further information, please refer to the CodeWarrior on-line help and on-line documentation provided.

1.6 Recommended Reading

This documentation describes how to use the AK-S12NE64-A Starter Kit and how to set up basic debugging sessions with Metrowerks CodeWarrior. Additional information can be found in the following documents:

- **MC9S12NE Datasheets;**
- **Freescale TCP/IP PowerPoint Tutorials;**
- **AK-S12NE64-A Schematic;**
- **OpenTCP Function Reference.**

All of the above documents (and many more) are available in the AK-S12NE64-A **"System Software"** CD-ROM.

1.7 Software Upgrades

The latest version of the AK-S12NE64-A system software is always available free of charge from our website: *http://www.softecmicro.com.*

When installing the AK-S12NE64-A system software you have the option to electronically register the product. If you register the product, you will be automatically notified by e-mail every time a new version of the AK-S12NE64-A system software is available.

1.8 Getting Technical Support

Technical assistance is provided to all customers. For technical assistance, documentation and information about products and services, please refer to your local SofTec Microsystems partner.

SofTec Microsystems offers its customers a technical support service at *support@softecmicro.com*. Before getting in contact with us, we advise you to check that you are working with the latest version of the AK-S12NE64-A system software (upgrades are available free of charge at *http://www.softecmicro.com*).

2 AK-S12NE64-A Components

2.1 Package Checklist

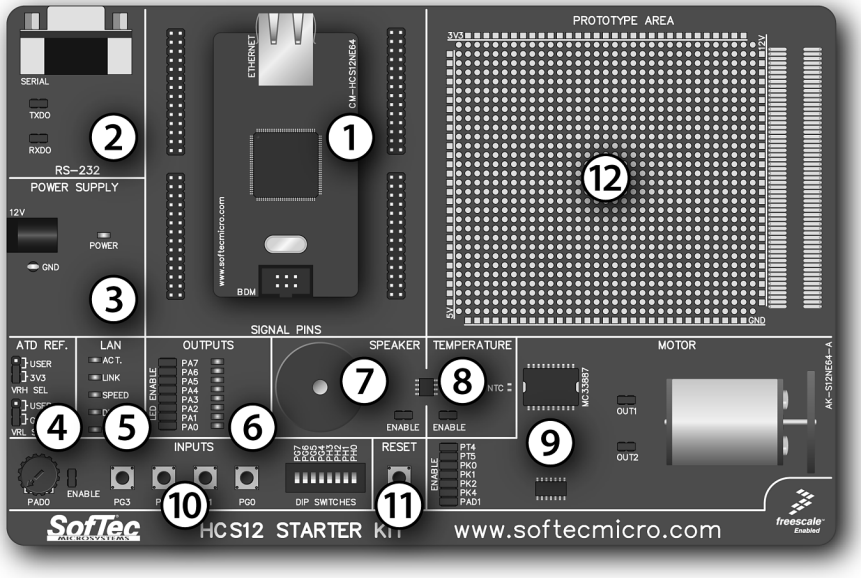
The AK-S12NE64-A package includes the following items:

- A general-purpose evaluation board base (AK-S12NE64-A);
- An Ethernet core module (CM-HCS12NE64);
- An AC adapter;
- An Ethernet cross cable;
- A serial cable;
- The SofTec Microsystems AK-S12NE64-A “System Software” CD-ROM;
- The Metrowerks CodeWarrior for HC(S)12 CD-ROM;
- This user’s manual.

2.2 The Evaluation Board

The following figure illustrates the main functions of the AK-S12NE64-A evaluation board.

2



AK-S12NE64-A Evaluation Board

1. CM-HCS12NE64 Core Module and signal pins section.
2. RS-232 section.
3. Power supply section.
4. ATD reference section.
5. LAN section.
6. Outputs section.
7. Speaker.
8. Temperature sensor.
9. DC Motor.
10. Inputs section.
11. Reset push-button.
12. Prototype area.

2.2.1 Core Module and Signal Pins Section

This area is dedicated to the hosting of the CM-HCS12NE64 Ethernet Core Module (described later). On the evaluation board, four connector strips are available with all of the Core Module's microcontroller signals (one-to-one correspondence).

2.2.2 RS-232 Section

This area contains an RS-232 connector (D-Sub, 9-pin female connector), an RS-232 transceiver, and two jumpers to connect/disconnect the SCI0_TXD and SCI0_RXD signals to/from the microcontroller.

The RS-232 connector can be used to communicate with the PC and take advantage of the Core Module's microcontroller's pre-programmed serial monitor to download and debug your application.

2.2.3 Power Supply Section

This area contains a 12 V DC input connector and generates two regulated voltages: 3.3 V DC and 5.0 V DC. The 12 V DC input voltage is also provided to the board.

A green "POWER" LED is connected to the 3.3 V line.

2.2.4 ATD Reference Section

This area contains two jumpers which allow you to define the high (VRH) and low (VRL) voltage reference for the MCU internal A/D converter.

2.2.5 LAN Section

This area contains five LEDs ("ACTIVITY", "LINK", "SPEED", "DUPLEX" and "COLLISION") which monitor the LAN status, connected to the respective microcontroller pins.

- The “ACTIVITY” LED blinks when packets are sent to/received from the Ethernet.
- The “LINK” LED indicates that an Ethernet link is available (the board is attached to another device, e.g. the PC or a hub).
- The “SPEED” LED indicates the Ethernet link speed (if turned on indicates a 100 Mbit/s speed, if turned off indicates a 10 Mbit/s speed).
- The “DUPLEX” LED indicates the Ethernet Duplex mode (if turned on indicates Full Duplex, if turned off indicates Half Duplex).
- The “COLLISION” LED indicates a packet collision.

2.2.6 Outputs Section

This area contains eight high-efficiency (low-current) LEDs connected to Port A, together with eight jumpers to connect/disconnect each of the eight LEDs to/from their respective microcontroller’s Port A pins.

2.2.7 Speaker Section

This area contains a piezoelectric speaker with the appropriate driving circuit. A jumper is present which connects/disconnects the speaker circuitry to/from the microcontroller’s PT6/TIM_IOC6 pin.

2.2.8 Temperature Section

This area contains an NTC temperature sensor and associated amplifier, calibrated to detect a temperature in the range 0-45°C. A jumper is present which connects/disconnects the temperature sensor circuitry to/from the microcontroller’s PAD2/AN2 pin.

The NTC temperature sensor is located near the H-bridge motor driver (MC33887), to allow the user application to detect the motor driver’s overtemperature. However, the featured motor will not generate any significant temperature increase, under any circumstances.

2.2.9 Motor Section

This area contains a brushed, permanent magnet, 12 V DC motor (0.95 A locked rotor current), together with a 5.0 A H-bridge motor driver (MC33887).

A series of jumpers allows you to connect/disconnect the lines required to interface the H-bridge motor driver to/from the microcontroller.

Two additional jumpers (OUT1 and OUT2) are available to connect/disconnect the motor to/from the H-bridge motor driver. This enables you to drive your own DC motor.

A red "FAULT" LED indicates the H-bridge motor driver's fault state.

A 0.5 A auto-restore fuse is present on the 12 V line used to power the H-bridge motor driver.

2.2.10 Inputs Section

This area contains various input controls: a potentiometer (together with a jumper to connect/disconnect it to/from the microcontroller's PAD0 pin), four push-buttons (connected to the microcontroller's PG3, PG2, PG1 and PG0 pins) and eight general-purpose DIP-switches connected to the microcontroller's Port H and Port G pins.

2.2.11 Reset Push-Button

The Reset push-button is directly connected to the microcontroller's RESET pin.

2.2.12 Prototype Area

The prototype section features both a standard, thru-hole area (for mounting traditional components) and a SMD area (for soldering SMD components in SOIC package).

2.3 The Ethernet Core Module

The CM-HCS12NE64 Ethernet Core Module is the heart of the AK-S12NE64-A Starter Kit. It features:

- A 112-pin LQFP MC9S12NE64 microcontroller;
- A 10/100 Base T integrated RJ45 Ethernet connector (with integrated magnetic isolation module);
- An 8 Mbit (1 MByte x 8) serial FLASH memory;
- A 4 Kbit (512 Bytes x 8) serial EEPROM;
- A 25 MHz crystal oscillator;
- A Reset supervisor circuitry;
- A BDM connector for in-circuit debugging/programming;
- Two header connectors to connect to the AK-S12NE64-A evaluation board base with all of the microcontroller's signals.

Tip: *the Ethernet Core Module only requires a 3.3 V DC power supply to work. The Ethernet Core Module can be used as the main building block in a user-designed embedded system.*

3 Getting Started

3.1 Introduction

The AK-S12NE64-A Starter Kit comes already pre-programmed with a firmware that demonstrates all of the main features of both the board hardware and the TCP/IP protocol suite. To easily learn these features, we have created a step-by-step tutorial organized in the following lessons:

1. Setup a PC connection (using the provided Ethernet cross cable);
2. Test the board connection using the PING command;
3. Web server demo;
4. TCP and UDP communication;
5. AK-S12NE64-A Control Panel (Windows utility);
6. AK-S12NE64-A Control Panel (Java Applet);
7. Create your own WEB pages;
8. Connect the board to your LAN;
9. In-circuit debugging/programming.

3.1.1 Resetting Parameters to Factory Defaults

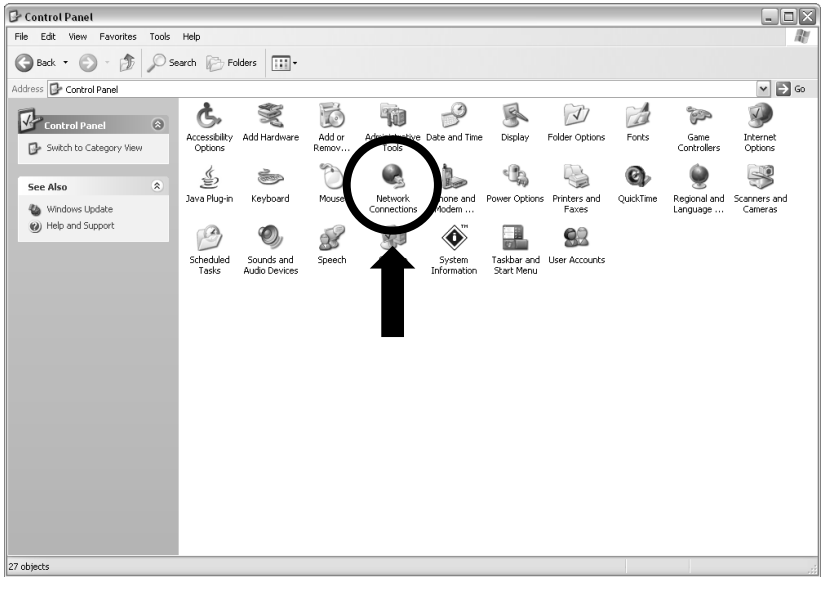
At any moment, all of the Starter Kit's board parameters can be restored to the factory default settings. To do so:

1. Press (and keep pressed) the RESET push-button;
2. Press (and keep pressed) the PG3 and PG2 push-buttons;
3. Release the RESET push-button;
4. Release the other push-buttons.

3.2 Lesson 1: Setup PC Connection

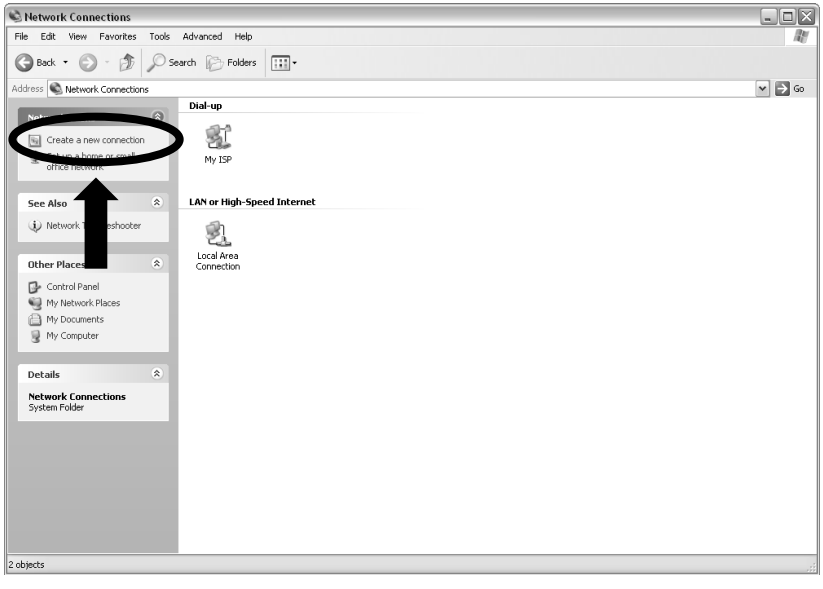
All the lessons in this tutorial require that the AK-S12NE64-A Starter Kit communicates with the host PC through a LAN connection. In this lesson you'll learn how to configure the PC to communicate with the starter kit using an Ethernet cross cable. The following steps are based on a Windows XP system.

1. Open the **Windows Control Panel** and open the **Network Connections** item.



Windows Control Panel

2. If a **Local Area Connection** is already available, go to step 8. Otherwise, run the **"New Connection"** wizard.



Network Connections

3. The following dialog box will appear. Click Next.

New Connection Wizard
Welcome to the New Connection Wizard
This wizard helps you:
• Connect to the Internet.
• Connect to a private network, such as your workplace network.
• Set up a home or small office network.
To continue, click Next.
< Back
Next >
Cancel

New Connection Wizard, Step 1

4. On the next dialog box, select the **"Connect to the Internet"** option and click the **"Next"** button.

New Connection Wizard
Network Connection Type
What do you want to do?
Connect to the Internet
Connect to the Internet so you can browse the Web and read email.
Connect to the network at my workplace
Connect to a business network (using dial-up or VPN) so you can work from home, a field office, or another location.
Set up a home or small office network
Connect to an existing home or small office network or set up a new one.
Set up an advanced connection
Connect directly to another computer using your serial, parallel, or infrared port, or set up this computer so that other computers can connect to it.
< Back
Next >
Cancel

New Connection Wizard, Step 2

5. On the next dialog box, select the **"Set up my connection manually"** option and click the **"Next"** button.

New Connection Wizard
Getting Ready
The wizard is preparing to set up your Internet connection.
How do you want to connect to the Internet?
Choose from a list of Internet service providers (ISPs)
Set up my connection manually
For a dial-up connection, you will need your account name, password, and a phone number for your ISP. For a broadband account, you won't need a phone number.
Use the CD I got from an ISP
< Back
Next >
Cancel

New Connection Wizard, Step 3

6. On the next dialog box, select the **"Connect using a broadband connection that is always on"** option and click the **"Next"** button.

New Connection Wizard
Internet Connection
How do you want to connect to the Internet?
Connect using a dial-up modem
This type of connection uses a modem and a regular or ISDN phone line.
Connect using a broadband connection that requires a user name and password
This is a high-speed connection using either a DSL or cable modem. Your ISP may refer to this type of connection as PPPoE.
Connect using a broadband connection that is always on
This is a high-speed connection using either a cable modem, DSL or LAN connection. It is always active, and doesn't require you to sign in.
< Back
Next >
Cancel

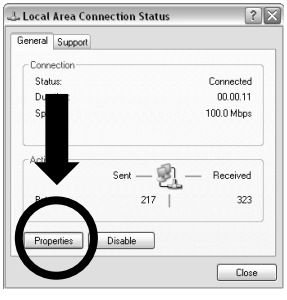
New Connection Wizard, Step 4

7. When the last dialog box appears, click the **"Finish"** button

New Connection Wizard
Completing the New Connection Wizard
Your broadband connection should already be configured and ready to use. If your connection is not working properly, click the following link.
Learn more about broadband connections.
To close this wizard, click Finish.
< Back
Finish
Cancel

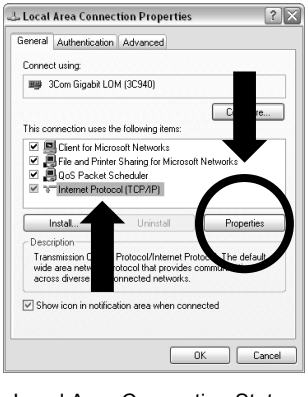
New Connection Wizard, Step 5

8. Open the newly created connection (or the existing connection if you are coming from step 2) and click the **"Properties"** button.



Local Area Connection Status

9. Select the **"Internet Protocol (TCP/IP)"** item and click the **"Properties"** button.

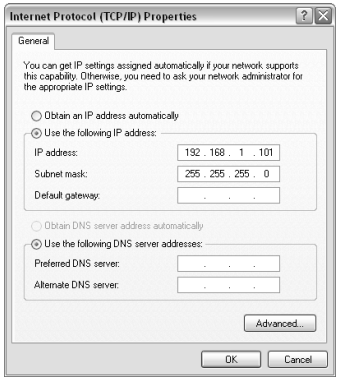


Local Area Connection Status

10. If you have started from an existing connection, write down all of the TCP/IP parameters. You'll need them later to restore your LAN settings to the original parameters.

11. Select the manual settings and type in the following values:

    IP address: **192.168.1.101**
    Subnet mask: **255.255.255.0**


Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
192 . 168 . 1 . 101
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

TCP/IP Properties

Click the **"OK"** button on all LAN setup dialog boxes.

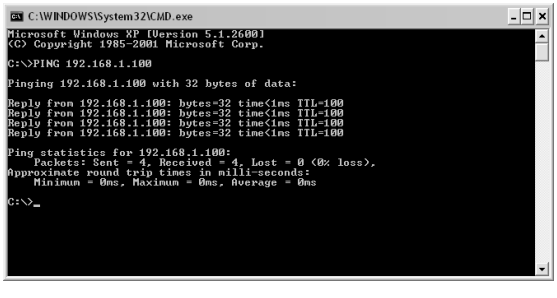
3.3 Lesson 2: Test Board Connection Using PING Command

In this lesson you will test the connection you created in the previous lesson.

1. Power up the board with the provided AC adapter and verify the POWER led turn on.
2. Connect the starter kit to the PC through the provided Ethernet cross cable.
3. Open a Command Prompt window (on Windows XP, from the Windows Start menu, select **Run**, enter **CMD** and click the **"OK"** button).
4. At the command prompt, type

   PING 192.168.1.100

   If the connection has been properly setup, the PING command will return a positive feedback.

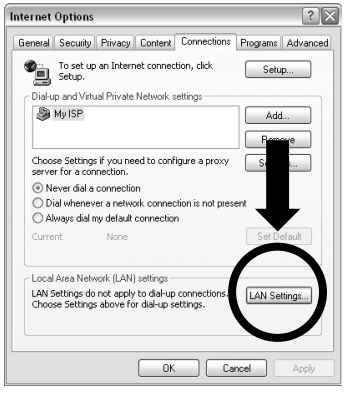


Pinging the Board

3.4 Lesson 3: Web Server Demo

In this lesson you will connect to the Starter Kit's built-in web server, which has some demonstration web pages pre-programmed in the core module's serial FLASH memory.

1. Launch your favorite web browser.
2. You must disable the proxy server, if one is enabled. To disable this feature (in Internet Explorer), open the **Internet Options** dialog box, go to the **Connections** tab, and click the **"LAN Settings"** button.



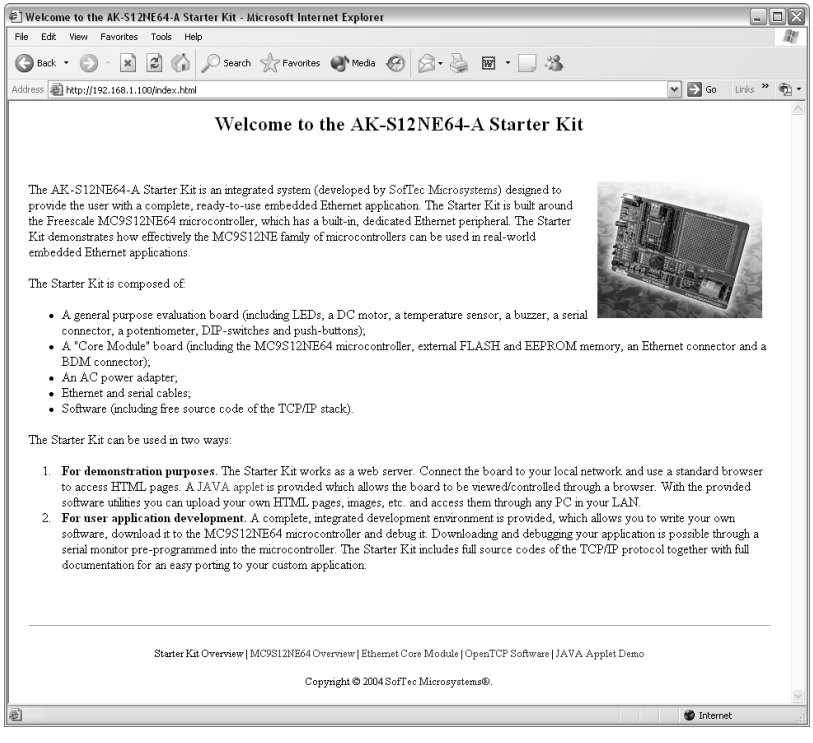
Disabling the Proxy Server, Step 1

Then, if the connection has a proxy enabled, make sure that the **"Use proxy server for your LAN"** option is disabled.

Local Area Network (LAN) Settings
Automatic configuration
Automatically detect setting
Use automatic configurat
Address
Use a proxy server for your LAN (These settings will not apply to dial-up or VPN connections).
Bypass proxy server for local addresses
OK
Cancel

Disabling the Proxy Server, Step 2

3. Connect to the following address: **192.168.1.100**. The Starter Kit's home page will appear.


Welcome to the AK-S12NE64-A Starter Kit - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://192.168.1.100/index.html
Go Links
Welcome to the AK-S12NE64-A Starter Kit
The AK-S12NE64-A Starter Kit is an integrated system (developed by SofTec Microsystems) designed to provide the user with a complete, ready-to-use embedded Ethernet application. The Starter Kit is built around the Freescale MC9S12NE64 microcontroller, which has a built-in, dedicated Ethernet peripheral. The Starter Kit demonstrates how effectively the MC9S12NE family of microcontrollers can be used in real-world embedded Ethernet applications.
The Starter Kit is composed of:
A general purpose evaluation board (including LEDs, a DC motor, a temperature sensor, a buzzer, a serial connector, a potentiometer, DIP-switches and push-buttons);
A "Core Module" board (including the MC9S12NE64 microcontroller, external FLASH and EEPROM memory, an Ethernet connector and a BDM connector);
An AC power adapter;
Ethernet and serial cables;
Software (including free source code of the TCP/IP stack).
The Starter Kit can be used in two ways:
1. For demonstration purposes. The Starter Kit works as a web server. Connect the board to your local network and use a standard browser to access HTML pages. A JAVA applet is provided which allows the board to be viewed/controlled through a browser. With the provided software utilities you can upload your own HTML pages, images, etc. and access them through any PC in your LAN.
2. For user application development. A complete, integrated development environment is provided, which allows you to write your own software, download it to the MC9S12NE64 microcontroller and debug it. Downloading and debugging your application is possible through a serial monitor pre-programmed into the microcontroller. The Starter Kit includes full source codes of the TCP/IP protocol together with full documentation for an easy porting to your custom application.
Starter Kit Overview | MC9S12NE64 Overview | Ethernet Core Module | OpenTCP Software | JAVA Applet Demo
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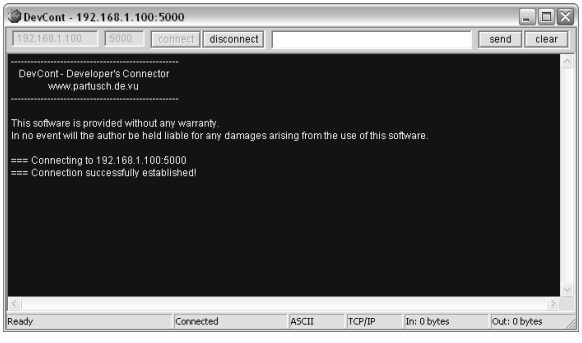
Internet

The Starter Kit's Default Home Page

3.5 Lesson 4: TCP and UDP Communication

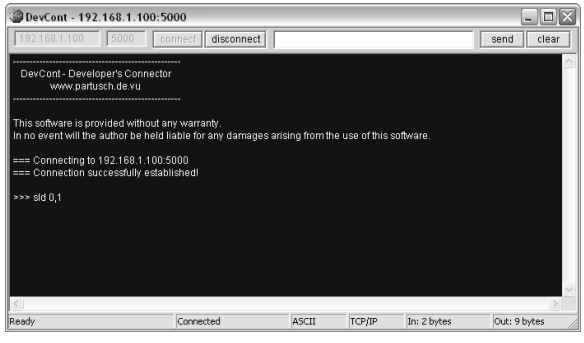
The Starter Kit firmware implements a simple, command-based, ASCII protocol over the TCP and UDP network protocols. By using a TCP/UDP terminal, you will control some of the Starter Kit's hardware resources.

1. The TCP/UDP terminal utility provided with the Starter Kit is called **DevCont** and is located on the SofTec Microsystems' **"System Software"** CD-ROM under the **AK-S12NE64-A\Utilities\DevCont** directory.
2. Copy the content of this directory to your hard drive and launch the **DevCont.exe** program.
3. Type in the board's address (**192.168.1.100**) and the port number (**5000**) and click the **"Connect"** button.



The DevCont Utility

4. After the communication has been established, type **"sld 0, 1"** and click the **"Send"** button. This command will turn on the PA0 LED.



Turning a LED On

5. The following table lists all of the available commands.

Command	Description	Returned Value
sld <*nled*>, <*status*>	Set Led Status (*nled* = 0..7, *status* = 0, 1)	-
gld <*nled*>	Get Led Status (*nled* = 0..7)	*nled* status (0, 1)
gsw <*nswitch*>	Get DIP-Switch Status (*nswitch* = 0..7)	*nswitch* status
gpt	Get Potentiometer Value	Potentiometer value (0..255)
gpb <*nbutton*>	Get Push-Button Value (*nbutton* = 0..3)	*nbutton* value (0,1)
gtp	Get Temperature Value	Temperature (0..45)
gms	Get Motor Speed	Motor speed (0..100)
sms <*speed*>	Set Motor Speed (*speed* = 0..100)	-
gmd	Get Motor Direction	Motor direction (0, 1)
smd <*mdir*>	Set Motor Direction (*mdir* = 0, 1)	-
gme	Get Motor Enable	Motor enable (0, 1)
sme <*enable*>	Set Motor Enable (*enable* = 0, 1)	-
gmc	Get Motor Current	Motor current (mA)
gmf	Get Motor Fault State	Motor fault state (0, 1)
sso <*enable*>	Set Speaker On (*enable* = 0, 1)	-
gso	Get Speaker On	Speaker enable (0, 1)
ssf <*freqmul*>	Set Speaker Frequency (*freqmul* = 1..50)	-
gsf	Get Speaker Frequency	Speaker frequency multiplier (1..50)

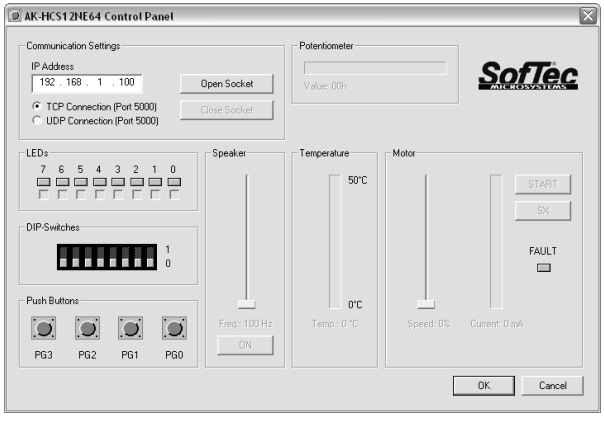
The Demonstrative Protocol Implemented in the Starter Kit

6. When finished experimenting with the DevCont utility, click the **"Disconnect"** button.

3.6 Lesson 5: Control Panel (Windows Utility)

The same protocol described in the previous lesson is used by a Windows application (AK-S12NE64-A Control Panel). This utility is located on the SofTec Microsystems' **"System Software"** CD-ROM under the **AK-S12NE64-A\Utilities\ControlPanel** directory.

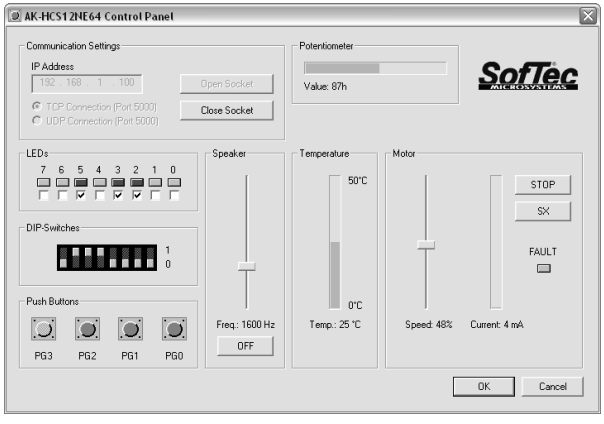
1. Copy the content of this directory to your hard drive and launch the **ControlPanel.exe** program.



The AK-S12NE64-A Control Panel (Windows Application)

2. Select the communication protocol (TCP or UDP).
3. Click the **"Open Socket"** button to start communicating with the Starter Kit.

4. The board's controls will continuously update, reflecting the board's real status.



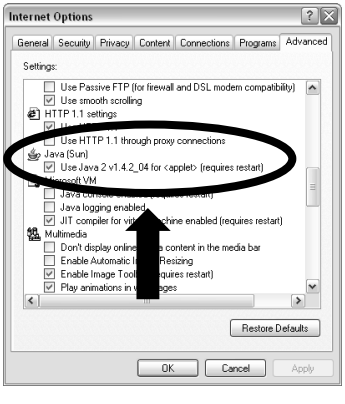
Real-Time Board Monitoring

5. The potentiometer, push-buttons, DIP-switches, temperature, motor current and motor LED are input-only controls; all other controls are input/output controls.
6. When finished testing the board, click the **"Close Socket"** button.

3.7 Lesson 6: Control Panel (Java Applet)

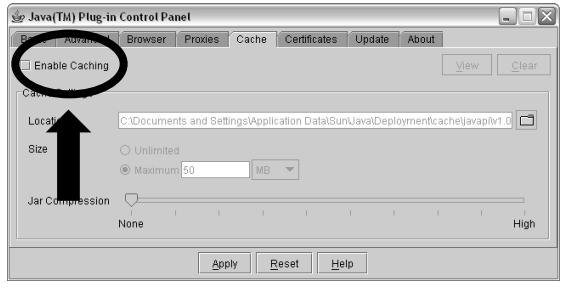
A similar utility to that explained in the previous lesson is available as a Java applet. This applet resides in the Starter Kit's FLASH memory, can be accessed through a browser, and is platform-independent. This applet has been developed using Sun Microsystems' Java 2 Platform, version 1.4.2. You need to have the Java 2 Runtime Environment (version 1.4.2) plug-in installed in your PC in order for the browser to execute the Java code.

1. The Java 2 Runtime Environment plug-in setup (for Windows) is located on the SofTec Microsystems' **"System Software"** CD-ROM under the **AK-S12NE64-A\Utilities\SunJava** directory.
2. Launch the setup and follow the instructions. Reboot your machine if requested.
3. Verify that the Java 2 Runtime Environment plug-in is enabled on your browser settings. If you are using Internet Explorer go to the **Advanced** tab in the **Internet Options** dialog box and verify that the Java Sun plug-in is enabled.



Enabling the Java 2 Runtime Environment Plug-In

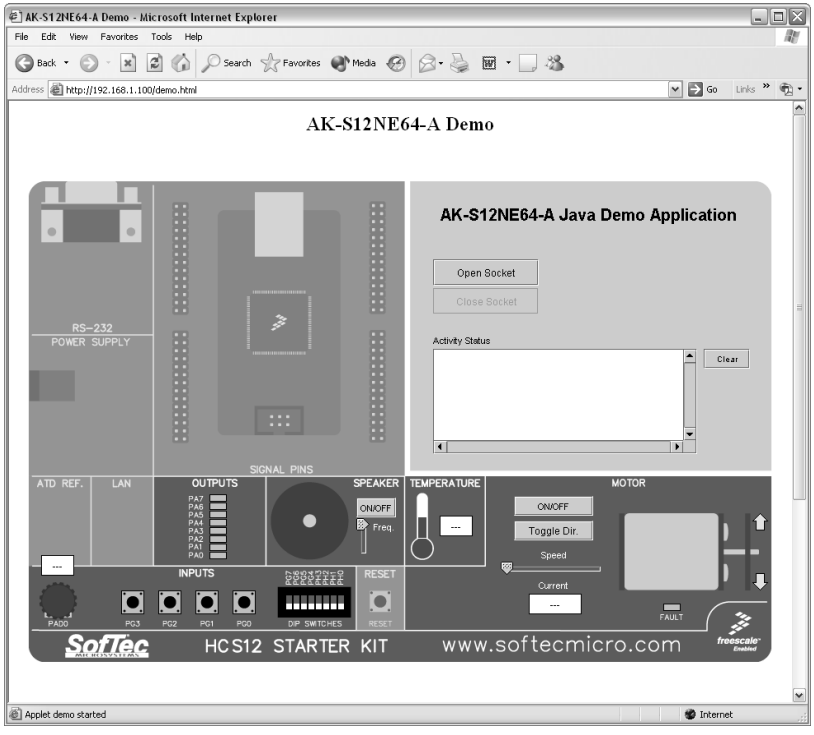
4. Make sure that the Java Plug-in cache is disabled. Go to the Windows Control Panel, open the **Java Plug-in** item and, in the **Cache** tab, disable the cache.



Disabling the Java Plug-In Cache

5. Launch your web browser and connect to **192.168.1.100/demo.html**.

6. The following HTML page (containing the Java applet) will appear.



AK-S12NE64-A Control Panel (Java Applet)

7. Click the **"Open Socket"** button to start communicating with the starter kit.
8. The board's controls will continuously update, reflecting the board's real status.
9. The potentiometer, push-buttons, DIP-switches, temperature, motor current and motor LED are input-only controls; all other controls are input/output controls.
10. When finished testing the board, click the **"Close Socket"** button.

3.8 Lesson 7: Create your own Web Pages

3.8.1 Introduction

The OpenTCP suite provides a simple web server; it does not provide, however, a file system, so that a problem arises when you need to store your web pages. Where to put them?

We solved this problem by creating a very simple “file system” which stores web pages in the Core Module’s external 1 Mbyte serial FLASH memory. This “file system” is nothing more than a data structure containing the file contents together with basic information such as file size and memory address where it is stored. To create this data structure we provide a simple DOS utility (**Web2Flash.exe**) that takes in a list of files you specify and automatically generates an output binary file that subsequently can be stored in the serial FLASH memory.

3.8.2 Limitations

You can create your own web pages with the tools you prefer; you can include images, java applets, and whatever you need to create your pages. However, due to the embedded nature of the web server, resources are scarce, and the web server cannot serve more than a small number of requests simultaneously.

By default, each web page cannot contain more than 3 external objects (such as images, .css files, java applets, etc.). This number is the total number of requests that the microcontroller can serve simultaneously. This number is related to both the number of users connected to the embedded web server and to the number of requests each single browser sends to the server.

This number can be increased by changing the **NO_OF_HTTP_SESSIONS** define in the **http_server.h** file. If only one browser connects to the server, a number of http sessions of 5 should be enough to handle most of the situations (browsers usually do not send more than a finite, small number of requests simultaneously).

3.8.3 Preparing the Files

All of the .html files and the other files that make up a website must be located in the same directory (on your PC). You can copy the sample files used to build the Starter Kit's default web pages to your hard disk. The files are located in the SofTec Microsystems' **"System Software"** CD-ROM under the **AK-S12NE64-A\Utilities\Web** directory. You can copy this directory to your hard drive and follow the steps in this lesson.

The **Web2Flash.exe** utility (explained in the next section) reads data from two configuration files and generates the binary file that will be stored in the Core's Module external FLASH memory.

The first configuration file (**demo.web** in this example) is a text file which contains the list of all of the .html files and the other files that make up the web pages. File names are case-sensitive.

The second file (**Web2Flash.ini**) is a separate configuration file that must be edited so that each file type making up your web site is properly defined. The contents of this file specify the **"content-type"** field for each of the file types in your web site. This field is part of the HTTP header that the embedded web server returns when a browser requests the corresponding file.

The **Web2Flash.ini** file already includes most common file types (and in particular, the file types needed to build the Starter Kit's sample web site); if your web site contains a file type non included in the list, you should add it, specifying the correct **"content-type"** string, otherwise browsers may not correctly interpret the file returned by the embedded web server.

3.8.4 Using Web2Flash.exe

The **Web2Flash.exe** utility takes in every file specified in the **.web** file, appends the appropriate HTTP response fields at the beginning of each files (including information about file size, file type, etc.) and generates the binary file that will be stored in the Core's Module external FLASH memory.

Usage: **Web2Flash.exe file-list.web**

where **file-list.web** is the text file which contains the list of all of the .html files and the other files that make up your web pages. A file **file-list.dat** will be automatically generated.

To generate the Starter Kit's web site, type:

Web2Flash.exe demo.web

and the **demo.dat** file will be generated.

3.8.5 Uploading

The generated file file-list.dat can be uploaded to the Core's Module external FLASH memory via TFTP (Trivial FTP) protocol, using the provided Ethernet cross cable. From the DOS prompt, type:

TFTP –i 192.168.1.100 PUT file-list.dat

where **192.168.1.100** is the default IP address of the Starter Kit. To upload the Starter Kit's .dat file generated in the previous section, type:

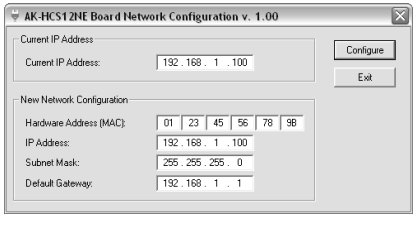
TFTP –i 192.168.1.100 PUT demo.dat

This operation erases all of the FLASH memory before to upload the new file. At the end of the uploading your website files can be accessed by a browser. If your site contains an index.html file, for example, you can view it by typing **"192.168.1.100/index.html"** in your browser's address box.

3.9 Lesson 8: Connect the Board to Your LAN

Before connecting the Starter Kit board to your LAN, the Starter Kit's IP address must be changed to match the LAN settings. To change the Starter Kit's IP address, do the following.

1. With the Starter Kit board still connected to the PC via the Ethernet cross cable, launch the **NetConfig.exe** utility that is located in the SofTec Microsystems' **"System Software"** CD-ROM under the **AK-S12NE64-A\Utilities\NetConfig** directory.


AK-HCS12NE Board Network Configuration v. 1.00
Current IP Address
Current IP Address:
192 . 168 . 1 . 100
Configure
Exit
New Network Configuration
Hardware Address (MAC):
01 23 45 56 78 9B
IP Address:
192 . 168 . 1 . 100
Subnet Mask:
255 . 255 . 255 . 0
Default Gateway:
192 . 168 . 1 . 1

The NetConfig Utility

2. Verify that the **"Current IP Address"** parameter corresponds to the currently used Starter Kit's IP address (default is **192.168.1.100**).
3. The **"Hardware Address (MAC)"** parameter is a unique hardware address that identifies the board across the network. No two devices can have the same MAC address. However, all of the SofTec Microsystems AK-S12NE64-A Starter Kits have the same MAC address. If you want to connect two or more Starter Kits on the same network, each must have a different MAC address.
4. Specify the new board's IP address, subnet mask, and default gateway address. To obtain these data, please contact your network administrator.
5. Click the **"Configure"** button. The new configuration will be stored in the Core Module's serial EEPROM memory. For the new configuration to be effective, you must reset the board.
6. You must now restore your PC network configuration to its original state (previously changed in Lesson 1).

7. Please note that the Ethernet cross cable provided can only be used to connect the Starter Kit to a PC; if you want to connect the Starter Kit to a hub, you must use an Ethernet patch cable.
8. Verify that the board is properly configured by issuing a PING command (as explained in Lesson 2, but this time using the board's new IP address).

3.10 Lesson 9: In-circuit Debugging/Programming

3.10.1 Introduction

The Core Module's microcontroller comes pre-programmed with a serial monitor that allows you to download your application into the microcontroller and debug it. The serial monitor communicates with the PC through a serial cable connected to the Starter Kit's RS-232 connector.

In this lesson you'll learn how to use the serial monitor together with Metrowerks CodeWarrior for HC(S)12 to write and debug your own applications.

Note: *in order to compile the provided example (which includes the OpenTCP software) you need a CodeWarrior license unlimited in size. To obtain such a license:*

1. *Contact Metrowerks to request a unlimited period, free license key to increase the code size limit to 12 KB; or*
2. *Contact Metrowerks to request a 30-day limited, free license key to run the compiler without limitations.*

3.10.2 Installing Metrowerks CodeWarrior IDE

To install the CodeWarrior IDE insert the CodeWarrior CD-ROM into your computer's CD-ROM drive. A startup window will automatically appear. Follow the on-screen instructions.

3.10.3 Connecting the Serial Cable

Connect the provided serial cable to a PC serial port and to the Starter Kit's RS-232 connector.

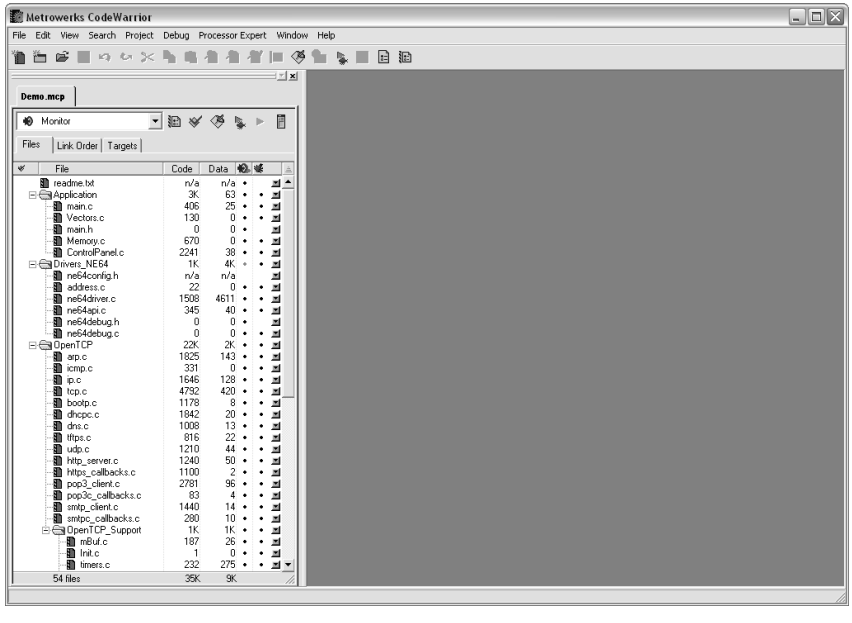
Make sure that both the **"TXD0"** and the **"RXD0"** jumpers are inserted.

3.10.4 Copying the Example

The demo example is located in the SofTec Microsystems' **"System Software"** CD-ROM under the **AK-S12NE64-A\Sources\Demo** directory. Copy this directory to your hard drive.

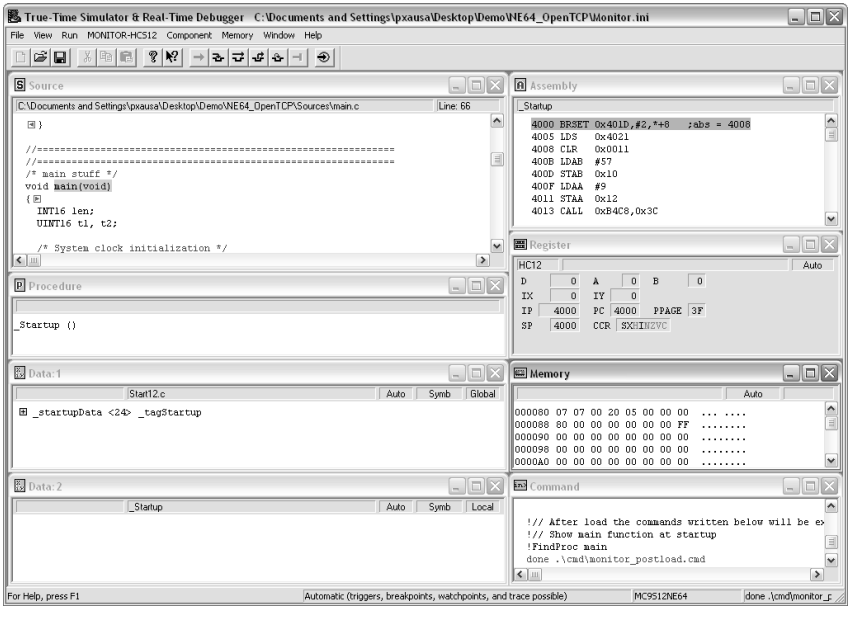
3.10.5 Launching the Example

1. Start the CodeWarrior HC(S)12 IDE by selecting **Start > Programs > Metrowerks CodeWarrior > CW12 > CodeWarrior IDE**. The CodeWarrior HC(S)12 IDE will open.
2. From the main menu, choose **File > Open**. Select the **"demo.mcp"** workspace located in the **NE64_OpenTCP** directory inside the "demo" directory you have copied from the CD. Click **"Open"**. The following window will appear.



Opening the Demo Project

3. Make sure that the default target is set to **"Monitor"** (from the main menu, choose **Project > Set Default Target > Monitor**.
4. **Reset the microcontroller to monitor mode by pressing (and keeping pressed) the RESET push-button and the PG0 push-button, and releasing them in the inverse order.**
5. From the main menu, choose **Project > Debug**. This will compile the source code, generate an executable file and download it to the AK-S12NE64-A Starter Kit board. A new debugger environment will open.



Debugging Session Started

6. From the main menu, choose **Run > Start/Continue**. The program will be executed in real-time. All of the features explained in the previous lessons are running.
7. You can now continue to experiment with the CodeWarrior user interface and discover by yourself its potentialities. For an in-depth guide of all of the user interface features, select **Help > CodeWarrior Help** from the CodeWarrior HC(S)12 IDE's main menu.

3.10.6 Serial Monitor Limitations

Due to the nature of the serial monitor (a piece of software running into the target microcontroller), some limitations to in-circuit debugging apply:

- 2 KB of Flash memory are reserved by the serial monitor (from address F800h to address FFFFh). This memory area cannot be erased/reprogrammed.
- The PLL peripheral is reserved by the serial monitor and should not be used by the user application. The serial monitor automatically sets the PLL to the maximum available frequency (50 MHz).
- The COP module is reserved as well and must not be used by the user application.
- The SCI0 peripheral is reserved and must not be used.
- Interrupts must be always enabled.
- SWI, SCI0 and CRG interrupt vectors should not be used.

Note: *pressing the RESET push-button on the Starter Kit's board will cause the user program to be restarted. To reset the microcontroller to monitor mode (the user program is not restarted):*

1. *Press (and keep pressed) the RESET push-button;*
2. *Press (and keep pressed) the PG0 push-button;*
3. *Release the RESET push-button;*
4. *Release the PG0 push-button.*

3.10.7 Serial Monitor Documentation

Detailed documentation about the serial monitor can be found in the AN2548/D Application Note, available in the SofTec Microsystems **"System Software"** CD-ROM.

3.10.8 BDM-Based Debugging

A better debugging approach would be to use a BDM-based debugging tool, such as SofTec Microsystems inDART-HCS12. This tool connects to the Core Module's BDM connector and allows for in-circuit programming and debugging without the limitations of the serial monitor.

4 Electrical Specifications

Parameter	Minimum	Typical	Maximum
Global Ratings			
Power Input Voltage	-	12 V AC/DC	-
Power Consumption	-	250 mA (motor on)	1 A (motor stalled)
Operating Temperature	0°C	-	50°C
Storage Temperature	-20°C	-	70°C
Humidity	-	-	90%
Motor (DC Permanent Magnet Brushed Motor)			
Nominal Power Supply	-	12 V	-
Power	-	1.5 W	-
No Load Speed	-	8700 rpm	-
No Load Current	-	0.07 A	-
Locked Rotor Torque	-	9 mNm	-
Locked Rotor Current	-	0.95 A	-
Speaker (Piezo Ceramic)			
Operating Voltage	1 Vpp	-	30 Vpp
Rated Current	-	< 1 mA	-
Sound Output at 4 KHz 10 cm	-	> 90 dB	-
Resonant Frequency	-	4000 ± 500 Hz	-
Temperature Sensor (NTC Resistor)			
Resistor @ 25°C (R_{25})	-	10 KΩ	-
Maximum Power	-	-	210 mW
Epcos No. of R/T characteristic	-	1011	-
Ethernet			
Speed		10/100 Mbit/s	
Connector Type		10/100 Base T integrated RJ45 without LED	
RS-232			
Speed	-	-	250 Kbit/s
Connector Type		D-Sub 9 pin female	
BDM			
Speed		Up to microcontroller's maximum speed	
Operating Voltage	-	3.3 V	-
Connector Type		Header connector 6 pin male	

Electrical Specifications

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